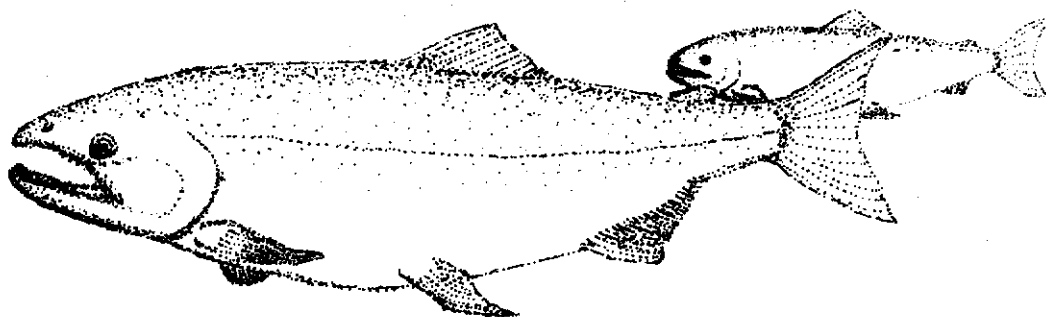


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1986 SURVEY RESULTS
A HISTORICAL COUNT REVIEW
AND HABITAT OBSERVATIONS

U.S. Fish and Wildlife Service
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NORTH FORK NOOKSACK SPRING CHINOOK SURVEYS: 1986 SURVEY RESULTS; A HISTORICAL COUNT REVIEW; AND HABITAT OBSERVATIONS

by Dave and Joanne Schuett-Hames

INTRODUCTION

This paper presents results of 1986 spring chinook spawning surveys for North Fork Nooksack tributaries and selected mainstem reaches. It also compares 1986 spring chinook counts with past survey records and discusses current habitat conditions.

STUDY AREA

The Nooksack River is located in northwestern Washington state on the west side of the North Cascade mountains just south of the Canadian border. The North Fork Nooksack is the northernmost of the three major forks of the Nooksack River. It originates in the glaciers and snowfields on the north sides of Mt. Shuksan and Mt. Baker. Due to its glacial nature winter flows are moderate except during major rain-on-snow events; summer flows are higher due to runoff from extensive glacial melt during warm weather.

Two tributaries of the North Fork Nooksack drain the glaciers of Mt. Baker. These tributaries supply a large percentage of the total flow of the North Fork Nooksack during the summer months. They also contain high concentrations of suspended sediments in the form of very fine glacial flour giving the North Fork Nooksack its characteristic muddy brown summer color.

The remaining tributaries originate in lower surrounding mountains and are fed by rainwater and snowmelt. They have high winter peak flows, consistent flows during spring and early summer snowmelt, and low flows (or are occasionally dry) during late summer and early fall.

There are 28.4 miles of habitat available to anadromous fish in the North Fork Nooksack from its confluence with the South Fork near Deming to the natural barrier of Nooksack Falls. From the Falls downstream to the town of Glacier, narrow, steep gradient bedrock confined canyons alternate with broader, lower gradient depositional areas with extensive gravel bars and sidechannels. Further downstream the valley broadens and the stream gradient lessens. Extensive gravel deposits occur here and the river exhibits a complex system of braided channels running through gravel bars and revegetating floodplain deposits. Most spring chinook spawning activity occurs in these braided channel areas which typically contain an abundance of spawning gravel.

Most tributaries of the North Fork Nooksack are high gradient streams which drain steep mountain slopes. The amount of area available to anadromous fish is often limited by barrier falls occurring in steep bedrock canyons a short distance up from the mouth. In Deadhorse and Boyd Creeks for example, the falls occur at river miles 0.1 and 0.2, while in Racehorse Creek a barrier fall occurs at river mile (RM) 1.4. Often a temporary barrier such as a log jam or boulder/debris dam occurs even farther downstream and may block fish passage for a number of years before being dislodged by a storm event. Consequently most spawning

occurs near mouths of creeks in low gradient channel reaches formed on the North Fork Nooksack's floodplain. In addition, gravel deposition at or near the creek mouth causes subsurface flow or flows too low to allow chinook access August through mid-September in several historical chinook streams, effectively taking these streams out of production. Suitable spawning habitat in most tributaries is limited; however large concentrations of spawning spring chinook have been occasionally observed, particularly in some of the larger tributaries such as Canyon Creek.

METHODS

Spawning ground surveys were conducted August 8 through September 15, 1986 by walking survey reaches and recording numbers and locations of live and dead chinook and their redds. Fork lengths and scale samples were taken whenever possible from carcasses. All carcasses were examined for adipose fin clips; snouts were removed from clipped fish to allow recovery of coded wire tags. Tails were removed from carcasses to avoid recounting on future surveys. Most tributaries were surveyed on a weekly basis. During the latter part of the survey period, visibility improved in the North Fork Nooksack and more effort was placed on carcass recovery in the mainstem at the expense of further surveys on tributaries which had been unproductive up to that point.

RESULTS

Appendix I presents locations, dates and results of the 1986 North Fork Nooksack spring chinook surveys. Surveys were done on 15 tributaries, and 23 North Fork reaches. One survey was done at the mouth of the Middle Fork Nooksack.

Spring chinook were observed in only two tributaries: Canyon Creek (RM 0.4-1.0); and, Kendall Creek (RM 0.0-0.2). Spring chinook were observed in the North Fork at 10 locations between RM 45.4 (Coal Creek area) and RM 63.4 (Deadhorse Slough).

Survey and visibility conditions were good in the tributaries (except Glacier Creek) throughout the survey period. North Fork Nooksack conditions were poor until the second week of September when cool weather allowed the river to lower and clear-up.

Table 1 shows the 1986 area totals for survey reaches in which spring chinook were observed. These figures were developed using the highest live and/or dead count for the reach. In cases where the estimated total for a sub-area based on redd counts (assuming two fish per redd based on field observations) exceeded the number of fish actually observed the redd count estimate was used as an upper range and is shown in parenthesis. The total derived is dependent upon factors such as visibility and accessibility and therefore is not a population estimate. However this information was used to develop a population estimate by the spring chinook technical committee (this committee is comprised of tribal, state fisheries and U.S. Fish and Wildlife Service personnel involved in the recovery of Nooksack spring chinook stocks). Their estimate is included in the discussion portion of this paper.

Table 1. USFWS 1986 North Fork Nooksack chinook survey area totals, (using highest live, dead or redd counts). Please note this is not a population estimate; actual populations are likely substantially higher. Areas without sightings are not included.

Area	Type of Count (Number)	# of Fish Represented
Canyon Cr.	Dead (4); Redd (7)*	4
Kendall Cr.	Live & Dead (13); Redd (16)	13 (to 32)
N.F. Nooksack		
Coal Creek Vicinity	Live & Dead (6)	6
Kendall Hatchery	Live & Dead (2)	2
Upper Racehorse	Live (1)	1
Kendall Farmhouse	Live & Dead (20)	20
Upper Kendall Farm- house / Glen	Live (6)	6
Aldrich Vicinity	Live (7); Redd (6)	7 (to 12)
Boulder Vicinity	Live (13); Redd (12)	13 (to 24)
Canyon Vicinity	Live (2)	2
Hedrick Vicinity	Live & Dead (7); Redd (4)	7 (to 8)
Deadhorse Vicinity	Dead (1)	1
Fish Total		82 (to 118)

* Fish appeared to have made multiple redds due to sparsity of spawning gravels. The redd count therefore was difficult to translate into numbers of fish.

A total of 82 spring chinook were accounted for in the 1986 North Fork area spring chinook surveys (with a range of up to 118 using redd count data). In the North Fork Nooksack 65 (to 82) were observed, while 4 were observed in Canyon Creek, and 13 (to 32) were observed in Kendall Creek. The greatest concentrations of spring chinook were seen in the following areas: in Kendall Creek; in the North Fork at the Kendall farmhouse with 20; at Boulder vicinity with 13 (to 24); Aldrich vicinity with 7 (to 12); and, at Hedrick vicinity with 7 (to 8). Notably, only 1 chinook was found in the uppermost accessible 8.5 miles of the North Fork.

Table 2 gives information on carcass recoveries, including date, river mile, fork length, age, sex and presence of tags. Approximate location of carcass recoveries is shown in Figure 1. Carcasses were typically recovered at or near spawning locations; thus the map in Figure 1 depicts locations where chinook spawned. A total of 44 carcasses were recovered in 1986 with 4 in Canyon Creek, 6 in Kendall Creek, and 34 in the North Fork between RM 44.6 and RM 63.4. Only 2 of the carcasses had adipose clips, signifying the presence of coded wire tags. Both fish were in the North Fork just below Kendall hatchery. Several live chinook with adipose clips were observed in Kendall Creek however no tagged carcasses were recovered there. Eight carcasses were either decomposed or extensively eaten by wildlife (especially bald eagles) making it impossible to distinguish whether clips were present. In most of these cases the snout was also eaten.

Scales were read to determine ages of 36 carcasses. Nine fish (25%) were five years old; seven of these had one spring of freshwater residence and two had two springs. The latter two were found the furthest distance up the North Fork of any carcasses, at RM 63.4 (near Deadhorse Creek), and RM 56.2 (near Hedrick and Cornell Creeks). A two-year-old jack and a four-year-old with two springs of freshwater residence were recovered from Kendall Creek. The majority of the carcasses recovered (69%), were four years old with one freshwater spring.

Carcass recoveries indicated two visually distinct subgroups of chinook were present during the survey period, based on size, coloration and timing. The majority were not bright (dull silver to black in coloration), had adult fork lengths ranging from 58 to 102 (average 80-85) and were recovered from August 25 to September 15. During the last two weeks of the survey period, roughly September 7 on, chinook were observed that were visually different. They tended to be larger than average (88 to 106 cm) and were bright green in coloration. These chinook appeared to spawn and die while still relatively bright. Don Hendrick (personal communication) made similar observations while capturing spring chinook broodstock for Kendall Hatchery in the early 1980's. Unfortunately the two types were not separated in our records. In future years separating the two types for record keeping purposes as well as collecting electrophoresis data to determine the genetic relationship would be useful.

Table 2. North Fork Nooksack 1986 Spring Chinook Carcass Recovery (U.S. Fish and Wildlife Service).

CARCASS #	STREAM (WRIA#)	RIVERMILE	DATE	SEX	LENGTH (CM)	TAG		?	AGE**	LENGTH (CM)
						AD CLIP	NO CLIP			
1	Canyon Cr. (0437)	00.4	Aug. 25	F	58		X		4(1)	76
2	N.F. Nooksack (0120)	45.4	Aug. 30	F	86	X*			4(1)	81
3	N.F. Nooksack (0120)	56.1 - LBSC	Aug. 30	F	88		X		4(1)	89
4	Canyon Cr. (0437)	00.8	Aug. 31	F	84		X		4(1)	-
5	Canyon Cr. (0437)	00.5	Aug. 31	M	89		X		5(1)	-
6	Canyon Cr. (0437)	00.5	Aug. 31	?	76			?		-
7	N.F. Nooksack (0120)	51.95- LBSC	Sept. 6	?	-			?		-
8	N.F. Nooksack (0120)	56.1 - LBSC	Sept. 6	M	87		X		4(1)	-
9	Kendall Cr. (0406)	00.1	Sept. 7	M	89		X		4(1)	
10	Kendall Cr. (0406)	00.0	Sept. 7	M	39		X		2(1)	39
11	N.F. Nooksack (0120)	46.95	Sept. 8	F	84		X		4(1)	58
12	N.F. Nooksack (0120)	47.1 - RBSC	Sept. 8	M	88		X		4(1)	81
13	N.F. Nooksack (0120)	47.05- RBSC	Sept. 8	F	81		X		4(1)	83
14	N.F. Nooksack (0120)	47.2 - LBSC	Sept. 8	F	91		X		4(1)	83
15	N.F. Nooksack (0120)	47.4 - RBSC	Sept. 8	F	96		X		5(1)	83
16	N.F. Nooksack (0120)	55.15- RBSC	Sept. 8	?	83		X		4(1)	84
17	N.F. Nooksack (0120)	63.4 - LBSC	Sept. 12	M	102		X		5(2)	84
18	N.F. Nooksack (0120)	51.3	Sept. 13	F	91		X		4(1)	85
19	N.F. Nooksack (0120)	51.9	Sept. 13	F	-			?		85
20	N.F. Nooksack (0120)	51.9 - LBSC	Sept. 13	M	-			?		86
21	N.F. Nooksack (0120)	51.9 - LBSC	Sept. 13	?	-			?		86
22	N.F. Nooksack (0120)	56.05- LBSC	Sept. 13	F	89		X		4(1)	86
23	N.F. Nooksack (0120)	56.05- LBSC	Sept. 13	F	100		X		5(1)	86
24	N.F. Nooksack (0120)	56.1 - LBSC	Sept. 13	?	-			?		87
25	N.F. Nooksack (0120)	56.2 - LBSC	Sept. 13	F	85		X		5(2)	87
26	N.F. Nooksack (0120)	47.0	Sept. 14	F	98		X		5(1)	88
27	N.F. Nooksack (0120)	47.05	Sept. 14	M	96			?	4(1)	88
28	N.F. Nooksack (0120)	47.05	Sept. 14	F	91		X		4(1)	89
29	N.F. Nooksack (0120)	47.05	Sept. 14	F	85		X		4(1)	89
30	N.F. Nooksack (0120)	47.25	Sept. 14	F	83		X		4(1)	89
31	N.F. Nooksack (0120)	47.3	Sept. 14	F	106		X		5(1)	91
32	N.F. Nooksack (0120)	47.35	Sept. 14	F	87		X		4(1)	91
33	N.F. Nooksack (0120)	47.55	Sept. 14	F	83		X		4(1)	91
34	N.F. Nooksack (0120)	47.6	Sept. 14	M	89		X		4(1)	96
35	N.F. Nooksack (0120)	44.6 - RBSC	Sept. 15	?	81		X			100
36	N.F. Nooksack (0120)	45.0	Sept. 15	?	86			?	5(1)	85
37	N.F. Nooksack (0120)	45.0	Sept. 15	M	89		X			86
38	N.F. Nooksack (0120)	45.3	Sept. 15	?	100		X		4(1)	88
39	Kendall Cr. (0406)	00.1	Sept. 15	?	86		X		4(1)	89
40	Kendall Cr. (0406)	00.15	Sept. 15	F	88		X		5(1)	96
41	Kendall Cr. (0406)	00.5	Sept. 15	F	86		X		4(1)	98
42	Kendall Cr. (0406)	00.5	Sept. 15	F	85		X		4(2)	100
43	N.F. Nooksack (0120)	45.6	Sept. 15	?	85	X*			4(1)	106
44	N.F. Nooksack (0120)	45.75	Sept. 15	M	86		X		4(1)	85
										102

DISCUSSION

Comparison of 1985 and 1986 Counts

The North Fork Nooksack spring chinook spawning population has been difficult to estimate due to the extreme turbidity during the spring chinook spawning period in the mainstem North Fork and the instability of side channel spawning areas which make it difficult to compare counts from year to year.

In 1985 a population estimate of 335 naturally spawning North Fork drainage spring chinook was developed using a reverse Peterson population estimate (Mike MacKay, in prep.). Table 3 summarizes spawning survey data for both 1985 and 1986. These numbers represent only a part of the total population, particularly in the mainstem North Fork where visibility is poor and foot access to available habitat is limited. However, this information provides a useful comparison between the two years and was used to develop a run size estimate for 1986 with the 1985 reverse Peterson population estimate as a basis. A variety of escapement estimates ranging from 254 to 330 with an average of 292 were calculated. This figure was rounded off to 300 and was considered to be a reasonable estimate by the Nooksack spring chinook technical committee. This system of comparison uses the entire survey area as an index because fish are concentrated in different areas each year due to changing side channel conditions. It appears promising as a method to determine population estimates for North Fork Nooksack spring chinook in the future.

Table 3. North Fork Nooksack spring chinook spawning survey data for 1985 and 1986. The table includes: the number of spring chinook observed; the expanded count which includes redd data; the number of days of effort; and, the total river miles covered.

Year	Number Observed	Ex. Count	Days Effort	Fish /Day	Ex. Count /Day	Miles Effort	Fish /Mile	Ex. Fish /Mile
1985	95	133	30	3.167	4.433	51.6	1.841	2.578
1986	82	118	27	3.037	4.37	58.9	1.392	2.003

North Fork Nooksack (Mainstem) Spring Chinook Counts

Historical data on North Fork spring chinook numbers is sketchy (Washington Department of Fisheries computerized spawning survey data) but counts go back as far as 1943. Other surveys occurred in 1945, 1946, 1961, 1965, 1970, 1971, 1975, 1976, and 1980 - 1986. Counts from the 40's show us that chinook in the past were found in similar areas to where they have been found in the 80's: near the mouth of Canyon Creek; in the vicinity of Boulder Creek; and, near Hedrick and Cornell Creeks. Run timing also appears to be similar with live fish found the last two weeks in August and dead as well as live fish found the first two weeks

of September. Following is a synopsis of North Fork Nooksack areas with apparent high numbers or congregations of fish in the past:

1. A spot check of the North Fork at the mouth of Hedrick and Cornell Creeks in 1945 found 14 fish.
2. Counts done in 1961 in a one-half mile stretch near Boyd Creek found 23 fish (46 fish per mile). This area appears to have been used into the 70's with a count in 1975 of 6 fish in a .2 rivermile section (30 fish per mile). In 1983, 3 fish were found here, 1 was found in 1984, and 0 in 1985 and 1986.
3. Rivermile 51.0 - 52.2, which is known as the Aldrich, Hanson's farm, Boulder Creek area, had a high count in 1961 of 54 fish (29.2 fish per mile). In 1980, between rivermiles 49.7 and 52.2, 40 fish (16 per mile) were counted. An additional 47 fish (12.4 per mile) were reported in 1980 between rivermiles 45.9 - 49.7 (Kendall to Maple Creek). In 1981 in a .5 rivermile section at the Kendall farmhouse (rivermile 47.0 - 47.5), 22 fish (44 per mile) were counted.

The Kendall farmhouse reach was a top spring chinook spawning area in both 1985 (26 fish) and 1986 (20 fish) with 35 and 25 fish per mile, respectively. Other top areas in 1985 were Racehorse Slough (16 fish or 22 fish per mile) and the Aldrich vicinity (13 fish or 19 fish per mile). Kendall hatchery and Coal Creek vicinity also had congregations of fish.

Additional top 1986 spawning reaches were Boulder Creek vicinity (13 fish or 26 fish per mile) and the Hedrick - Cornell vicinity with 7 fish (13 fish per mile). The Aldrich vicinity, upper Kendall farmhouse, and Coal Creek areas also had significant although lesser amounts of fish. The Kendall to Maple Creek area, (which includes the top chinook reaches of Kendall hatchery vicinity, Racehorse vicinity, Kendall farmhouse and upper Kendall / Glen area) had no significant spring chinook counts prior to the 1980's. Due to the incomplete historical record, it is not clear whether this is due to a lack of counts or a lack of fish. In the Aldrich to Boulder Creek area, 1985 - 86 counts approach, but are still lower than historical counts.

The most significant change in spring chinook distribution and numbers appears to be the near extirpation of spawners in the Boyd and Deadhorse Creek vicinities. This is a serious situation, and should be a priority to rectify. Outplanting of Kendall-reared wild chinook as soon as possible to this vicinity would be a possible solution. It is likely that egg incubation and juvenile rearing conditions are among the best in the North Fork in this reach due to its upstream location.

Several of the major spring chinook spawning areas appear to be in locations vulnerable to tributary gravel flush outs where a poor survival rate would likely occur. Most notable are spawning reaches at the mouths or downstream of Cornell Creek (Hedrick - Cornell vicinity) and Boulder Creek (Boulder and Aldrich vicinities). These concerns are further discussed in the section on habitat disturbance.

North Fork Nooksack Tributary Counts

Historical spring chinook surveys for the North Fork tributaries are spotty until the late 1970's in most cases. Since the late 1970's survey effort has been good in most of the larger tributaries. Appendix

II summarizes peak counts for the tributaries, historical to present; the highest chinook count for each year with what seemed to be appropriately timed surveys is given. Survey dates included were those within August and within September 1 - 21 (a few later surveys were included if they were primarily dead fish).

Of 19 tributaries which have surveys on record, Bell, Boyd, Cascade, Coal (0487), Fossil, Gallup, Glacier, Hedrick, Lookout and Thompson have no recorded chinook sightings. In most cases few surveys have been done on these streams so the information may be misleading.

Three streams have had limited spring chinook use with high counts of 1 chinook for Coal Creek (0402), 5 for Deadhorse, and 3 for Kenney. Again, the survey record is limited for these streams.

The remaining 6 streams, Maple, Racehorse, Boulder, Cornell, Canyon and Kendall Creeks, had records of significant and/or consistent use. The survey coverage is better on these streams but spotty prior to 1976. Many of the peak counts were recorded in 1981 during a period of high turbidity in the North Fork Nooksack.

Maple Creek had 13 spring chinook in 1980 and 30 in 1981 however no chinook have been observed since 1984.

Racehorse Creek has a history of consistent usage with a high count of 35 in 1979. None have been seen there since 1983, probably as a result of the severe habitat disturbance that has occurred.

Boulder Creek has a fairly consistent record of low numbers of chinook with a high count of 14 in 1981. None have been seen since 1982 which coincides with severe channel disturbance.

Cornell Creek had consistent usage with a high count of 20 in 1947. However the last record was in 1978 which also coincides with excessive sedimentation and channel disturbance.

Canyon Creek has a history of consistent utilization and a high count of 208 fish in 1981. It has continued to receive limited use despite repeated habitat disturbance from debris floods in recent years. Spring chinook populations in Canyon Creek are declining and will likely be extirpated if the present rate of redd destruction from massive sediment deposition continues.

Kendall Creek has a record of consistent fish use with a high count of 44 in 1981. Hatchery strays undoubtedly account for many of the sightings. Nonetheless, the 0.2 miles of Kendall Creek below the hatchery weir is currently the most significant tributary reach for naturally spawning spring chinook.

Of the six historically significant North Fork tributaries used by spring chinook, Kendall Creek appears to be the only remaining tributary with habitat conditions conducive to spring chinook spawning and intergravel survival. The section on habitat disturbance (below) discusses stream conditions further.

Effect of Habitat Disturbance on Spring Chinook Survival

Although no systematic attempt was made to assess effects of habitat disturbance on chinook populations, many observations have been made concerning disturbance of spring chinook spawning areas and destruction of spring chinook redds.

The most serious problem observed in the North Fork drainage was

disturbance of eggs in the gravel due to channel instability. Instability causes channel shifting during high flows and deposition of sediment and debris on redds. One example occurred at Racehorse Slough, an important side channel for spawning spring chinook in 1985. By spring of 1986 the channel's upper end had filled in, cutting off flow to the lower end. This apparently happened during a storm near the end of February, 1986 (prior to peak emergence for North Fork spring chinook) and likely caused extensive mortality. Additional mortality to 1985 brood also likely occurred due to channel changes in a side channel across from Kendall farmhouse (RM 47.3 to 47.6) and in a braided channel reach in the vicinity of Aldrich Creek.

Some instability and channel shifting is expected to occur in braided channel areas such as those preferred by spawning spring chinook. Braided channels are characteristic of glacial streams which carry a naturally high sediment load. However, the widespread and detrimental effects of channel instability in the North Fork Nooksack have been associated with major storm events during which tributary watersheds "flush out" contributing large amounts of sediment directly into mainstem spawning reaches. During a January 1984 storm, Canyon, Boulder, and Racehorse Creeks put huge amounts of sediment directly into North Fork spring chinook spawning reaches as a result of debris torrents. Following the storm extensive shifting of the mainstem occurred from Canyon Creek to below Racehorse Creek, the most heavily used spawning area. In much of this reach the main channel shifted to the opposite side of the floodplain resulting in extensive loss of redds (John Drotts, personal communication).

Following a November 1986 flood, several areas where spring chinook had spawned were revisited to examine effects on 1986 brood redd survival. In two concentrations of redds at the Kendall farmhouse, channel changes were extensive and redd loss appeared total. At the Boulder Creek vicinity the channel location appeared similar to its prior location. However, woody debris and silt were deposited in the area making redd disturbance and suffocation likely. The upper section of the Hedrick, Cornell vicinity side channel had filled in with sediment and debris resulting in redd dewatering and siltation; downstream the tributaries provided flow and redd survival appears to be good. Although the November flood effects varied among spawning reaches revisited, the flood appeared overall to have caused extensive redd loss to the 1986 brood.

Disturbance of habitat in major spring chinook spawning tributaries has been extensive since the early 1980's. Destruction of redds and habitat loss due to debris torrent events and resulting excessive sediment deposition have been documented in most major chinook spawning tributaries, including Canyon, Boulder, Cornell, and Racehorse Creeks. In the latter three streams no spring chinook were observed in 1985 or 1986.

In 1982, spring chinook redds were marked in Racehorse, Canyon, and Deadhorse Creeks to allow later placement of fry traps. Habitat disturbance was severe and no redds could be relocated in the spring (John Drotts, personal communication). This appeared due to debris and sediment movement associated with a January 1983 rain-on-snow event.

Pink redds in Boulder, Cornell and Racehorse Creeks were marked in 1983 with scour monitors. These redds were in stream locations

historically utilized by spring chinook. Following the January 1984 rain-on-snow event, 100% redd destruction was documented in each stream. Aggradation of 3 feet in Racehorse Creek and 6 feet in Cornell Creek was measured (Lummi Fisheries Department, unpublished data). Additionally, aggradation was estimated at 6 feet in Canyon Creek (Rod Olson, personal communication), and over 10 feet in Boulder Creek where the Highway 542 bridge was buried.

In the winters of 1985-86 and 1986-87, storm related channel shifting again occurred in Racehorse, Cornell, Boulder and Canyon Creeks. In Canyon Creek all 1986 brood redds in the lower 0.7 miles of the stream were destroyed due to channel shifting and sediment deposition.

Another aspect of instability and sedimentation in the North Fork drainage is the proliferation of channelization and dredging projects. These are done to protect bridges and property from bank erosion and flood damage. Such projects aggravate damage to fish habitat by further reducing habitat diversity, instream structure and cover.

Following the 1983 and 1984 storm events, dredging was done on many tributaries. Major projects were undertaken on Boulder, Cornell, and Glacier Creeks to protect bridges on the Highway 542. Bulldozer work was done in Canyon and Racehorse Creeks.

Similar projects are occurring on the North Fork Nooksack. In 1986 a bank protection and channel modification project was done to protect the Glen at Maple Falls development from bank erosion. This project involved dredging, straightening and armoring of almost 1/2 mile of the North Fork Nooksack in a spring chinook spawning reach. Following channel modifications, habitat in the project area appeared unsuitable for spawning and no spawners were observed. The project likely affected downstream channel geomorphology, contributing to extensive channel changes observed immediately downstream at the Kendall farmhouse.

Current Habitat Conditions in Spring Chinook Spawning Tributaries

Canyon Creek habitat is severely impacted by the large amount of coarse sediment deposited in the anadromous reach during the January 1984 storm. These conditions were aggravated by the November 1986 storm. In the lower mile the habitat is composed primarily of uniform riffle/rapids dominated by highly compacted coarse cobble particles greater than 9 inches in diameter. Consequently there are almost no optimal spawning sites. This year there was a tendency towards multiple redds per female due to the difficulty in excavating redds in the coarse substrate and the lack of suitable gravel. There are few holding pools in the lower mile; additionally there is little woody debris to provide instream cover. The channel remains unstable in this reach and shifting occurs during high flows. A positive aspect of the 1984 storm was the washing out of a boulder/log jam which had been impeding migration of spring chinook beyond river mile 1.2. In 1985 spring chinook were seen spawning as far upstream as river mile 1.4.

Cornell Creek is affected by extensive debris deposition with channel changes occurring at almost every high flow. Habitat is dominated by riffles and rapids with coarse compacted substrates. The channel has dried up between RM 0.2-0.4 the last two years due to the

flow traveling subsurface through sediment deposits. There is still some good habitat near the creek's mouth, however flows have been too low for chinook access.

Boulder Creek has been repeatedly devastated by sediment deposits from debris flows events. Habitat is almost entirely riffles and rapids dominated by compacted coarse sediments greater than 9 inches in diameter. Additional aggradation and channel changes occur at every high flow. There is little prospect for channel stabilization and recovery in the near future.

Debris torrents in 1983 and 1984 affected Racehorse Creek by depositing masses of sediment and debris in the anadromous zone. The 1984 storm deposited a 1/2 acre debris jam at RM 0.4 blocking salmon passage until a channel was cleared around it a year and a half later. The storm additionally caused the channel to shift near the mouth cutting off 0.2 miles of channel. Currently, channel shifting occurs during high flows due to sediment deposits. Most of the sediment is gravel sized or smaller and domination of riffle habitats by coarse particles is not a problem below RM 0.8 although it is a problem upstream. Serious contamination of spawning gravels with fine sediments (less than .85 mm) occurs below the bridge where levels of 19.7% were recorded in 1983 (Schuett-Hames, 1984). Additional channel shifting and sediment and debris deposition occurred during the November 1986 storm. The channel below the RM 0.8 bridge has aggraded to where the channel elevation is above that of the surrounding lands and dredging is being considered to protect adjacent residents.

Maple Creek spawning habitat is currently sedimented, typified by sluggish flows and appears unsuitable for chinook spawning. However, the lower reach of this stream is not impacted by aggradation from debris torrents; as such it may provide the best tributary opportunity for immediate rehabilitation and reestablishment of a tributary spawning reach. Fencing and establishing a forested riparian zone to control cattle related sedimentation would be useful from approximately RM .1 to RM .7. In the lower .1 RM, better defining the channel with large logs to encourage higher velocities and flushing of sediments should be able to provide appropriate spawning conditions. There may be opportunities at this site to additionally gain more flow by diverting nearby ground water fed seeps into the creek.

Future Habitat Considerations for Spring Chinook Stock Recovery

Large amounts of sediment are being produced and transported to spawning reaches of tributaries and the mainstem. Given these conditions, it is unlikely spawning and incubating success will improve soon unless a weather change reduces major storm frequencies and allows flushing and channel stabilization. Peak Northwest, Inc. (1986) studied sediment production in Boulder, Canyon, Cornell and Racehorse watersheds. They found greatly increased volumes of sediment were being produced due to an acceleration of mass wasting by logging activity. Projects which reduce sediment production from tributary watersheds will promote long term channel recovery, first in tributaries and then in the mainstem North Fork Nooksack. Examples of such projects include the erosion control and road abandonment project undertaken in 1986 by the Department of Natural Resources in Racehorse Creek and a similar project

being planned for Canyon Creek by the U.S. Forest Service. The length of time needed for channel recovery to occur is not well understood, however.

Fisheries agencies developed a fish habitat improvement and channel stabilization plan for Racehorse Creek and are developing one for Canyon Creek. The first stage of the Racehorse plan was implemented in 1986. Flow was restored to a 0.2 mile long section of channel previously cut off due to sediment buildup. However, the project was damaged by high flows from the November 1986 storm, pointing out the need for erosion control and stabilization of the upper watershed before downstream projects can be successful in highly disturbed tributaries.

Until the amounts of sediment from tributary watersheds in the North Fork drainage are reduced to a level that allows channel stabilization and habitat recovery to occur, prospects for natural spring chinook population recovery are poor. Adult returns from broodyears where eggs were in the gravel during periods of severe redd disturbance occurred are predicted to be low. This would include brood years 1982, 1983, 1985 and 1986. If the present pattern of extensive sediment deposition and redd loss on an almost yearly basis continues, the natural production of spring chinook in Canyon Creek and the mainstem North Fork Nooksack will remain depressed or further decline, threatening the viability of the native North Fork spring chinook run.

SUMMARY AND RECOMMENDATIONS

1. 1986 Fish and Wildlife Service spring chinook surveys accounted for 82 fish (up to 118 using redd count data) in the North Fork Nooksack drainage. A total of 44 carcasses were recovered; 69% of these were four-year-olds with less than a year of fresh water residence.
2. Carcass recoveries indicated two visually distinct subgroups of chinook were present during the survey period. Separating the two types for record keeping purposes as well as collecting electrophoresis data to determine the genetic relationship would be useful in the future.
3. Using the 1985 and 1986 foot surveys in conjunction with the 1985 reverse Peterson spring chinook population estimate, it was possible to develop a relative run size of 300 spawners for 1986. This system of comparison uses the entire survey area as an index. It appears promising as a method to determine population estimates for North Fork Nooksack spring chinook in the future.
4. Historical North Fork surveys document similar run-timing and spawning locations to those found today. However, the current highly productive Kendall to Maple Creek reach doesn't show up in early records. Additionally, the run in the uppermost accessible 8.5 miles of the North Fork, which includes the historically used Boyd vicinity appears presently to be unutilized.
5. A priority for outplanting Kendall Hatchery reared spring chinook would be the North Fork Nooksack in the Boyd - Deadhorse Cr. vicinity in order to reestablish the run in a relatively stable area of the North

Fork with historical usage.

6. Habitat disturbance appears to be having a significant effect on the wild spring chinook population in the North Fork Nooksack drainage and is one of the main factors inhibiting stock recovery. Serious redd loss is estimated to have occurred in 1982, 1983, 1985 and 1986 brood years. This is predicted to reduce adult returns in subsequent cycles.

7. Of the six historically significant North Fork tributaries used by spring chinook (Boulder, Racehorse, Canyon, Cornell, Maple and Kendall Creeks), Kendall Creek appears to be the only remaining tributary with habitat conditions conducive to spring chinook spawning and intergravel survival. Channel shifting and sediment deposition is also affecting most spring chinook spawning areas in the North Fork Nooksack.

8. Habitat recovery and channel stabilization in the North Fork Nooksack and most tributaries are dependent on reducing sediment production and transport rates. Implementation of erosion control measures where needed will increase natural recovery rates.

9. Maple Creek may provide the best opportunity for immediate rehabilitation and reestablishment of a tributary spawning reach. Fencing, revegetating the riparian zone, and better defining the channel with large logs (to encourage higher velocities and flushing of sediments) should improve spawning conditions in this tributary.

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APPENDIX I
1986 U.S. FISH AND WILDLIFE SERVICE NORTH FORK NOOKSACK SPRING CHINOOK SURVEY RESULTS

SURVEY LOCATION	RIVERMILE	DATE	PERCENT SEEN	NO. LIVE LIVE	LIVE TAG	LIVE NOTAG	LIVE ?TAG	NO. DEAD DEAD	DEAD TAG	DEAD NOTAG	DEAD ?TAG	TOTAL COUNT	NO. REDDS	COMMENTS (Nos. are WDF code)
Tributaries														
Bell Cr.	0.0-0.1	10-Aug-86	60	0				0				0		Dry above RM 0.1
Bell Cr.	0.0-0.1	30-Aug-86	99	0				0				0		Dry above RM 0.1
Boulder Cr.	0.2-0.6	09-Aug-86	70	0				0				0		20
Boulder Cr.	0.0-0.2	09-Aug-86	25	0				0				0		Braided below bridge
Boulder Cr.	0.0-0.2	22-Aug-86	50	0				0				0		60
Boulder Cr.	0.1-0.2	30-Aug-86	95	0				0				0		20
Boulder Cr.	0.1-0.2	06-Sep-86	95	0				0				0		20
Boulder Cr.	0.1-0.2	13-Sep-86	99	0				0				0		20,57
Boyd Cr.	0.0-0.2	10-Aug-86	90	0				0				0		20
Boyd Cr.	0.0-0.2	15-Aug-86	95	0				0				0		20
Boyd Cr.	0.0-0.1	23-Aug-86	99	0				0				0		20,57
Boyd Cr.	0.0-0.1	04-Sep-86	99	0				0				0		20
Boyd Cr.	0.0-0.1	12-Sep-86	99	0				0				0		20
Canyon Cr.	0.0-0.7	11-Aug-86	50	0				0				0		20,31
Canyon Cr.	0.7-1.6	11-Aug-86	35	0				0				0		20,31
Canyon Cr.	0.0-0.7	18-Aug-86	60	1	0	0	1	0				1	3	20,Chin. at RM 0.4
Canyon Cr.	0.7-1.4	18-Aug-86	75	1	0	0	1	0				1	2	20,chin at RM 1.0
Canyon Cr.	0.0-0.7	25-Aug-86	50	0				1	0	1	0	1	4	20,30,Chin at RM 0.4
Canyon Cr.	0.7-1.4	25-Aug-86	80	0				0				0	3	20
Canyon Cr.	0.0-0.7	31-Aug-86	15	0				2	0	1	1	2	7	21,32
Canyon Cr.	0.7-1.5	31-Aug-86	40	0				1	0	1	0	1	3	20,31,Chin at RM 0.8
Canyon Cr.	0.0-0.7	08-Sep-86	75	0				0				0		20
Canyon Cr.	0.7-1.6	08-Sep-86	15	0				0				0		20
Canyon Cr.	0.0-0.2	15-Sep-86	50	0				0				0		20
Coal Cr.	0.0-0.2	08-Aug-86	95	0				0				0		54,lower 0.1 mi dry
Coal Cr.	0.0-0.1	24-Aug-86	99	0				0				0		54
Cornell Cr.	0.0-0.6	09-Aug-86	80	0				0				0		20
Cornell Cr.	0.0-0.6	22-Aug-86	95	0				0				0		20,dry RM 0.2-0.4
Cornell Cr.	0.0-0.6	30-Aug-86	99	0				0				0		20,dry RM 0.2-0.4
Cornell Cr.	0.0-0.1	13-Sep-86	99	0				0				0		20,57
Deadhorse Cr.	0.0-0.1	10-Aug-86	50	0				0				0		20
Deadhorse Cr.	0.0-0.1	15-Aug-86	95	0				0				0		20
Deadhorse Cr.	0.0-0.1	23-Aug-86	95	0				0				0		20
Deadhorse Cr.	0.0-0.1	04-Sep-86	99	0				0				0		20
Deadhorse Cr.	0.0-0.1	12-Sep-86	99	0				0				0		20
Gallup Cr.	0.0-0.3	09-Aug-86	75	0				0				0		20
Gallup Cr.	0.0-0.3	22-Aug-86	95	0				0				0		20
Gallup Cr.	0.0-0.3	04-Sep-86	95	0				0				0		20
Glacier Cr.	0.0-0.2	09-Aug-86	5	0				0				0		09,38
Glacier Cr.	0.0-0.2	22-Aug-86	5	0				0				0		09,38
Hedrick Cr.	0.0-0.2	09-Aug-86	95	0				0				0		20
Hedrick Cr.	0.0-0.2	22-Aug-86	95	0				0				0		20
Hedrick Cr.	0.0-0.2	30-Aug-86	99	0				0				0		20,57
Hedrick Cr.	0.0-0.2	06-Sep-86	99	0				0				0		20
Hedrick Cr.	0.0-0.1	13-Sep-86	99	0				0				0		20,57
Kendall Cr.	0.0-0.2	08-Aug-86	20	0				0				0		turbid below RM 0.15
Kendall Cr.	0.0-0.2	17-Aug-86	70	0				0				0		20
Kendall Cr.	0.0-0.2	24-Aug-86	65	0				0				0	2	60

Kendall Cr.	0.0-0.2	30-Aug-86	40	2	0	1	1	0				2	3	60
Kendall Cr.	0.0-0.2	07-Sep-86	99	11	5	3	3	2	0	2	0	13	13	20
Kendall Cr.	0.0-0.2	15-Sep-86	99	5	0	3	2	4	0	4	0	9	16	23
Kenny Cr.	0.0-0.1	10-Aug-86	95	0				0				0		20
Maple Cr.	0.0-0.4	09-Aug-86	80	0				0				0		20
Maple Cr.	0.0-0.4	17-Aug-86	70	0				0				0		20
Maple Cr.	0.0-0.4	22-Aug-86	90	0				0				0		20
Maple Cr.	0.0-0.4	30-Aug-86	95	0				0				0		20,33
Racehorse Cr.	0.0-0.6	08-Aug-86	80	0				0				0		20,40
Racehorse Cr.	0.6-0.8	08-Aug-86	80	0				0				0		20
Racehorse Cr.	0.0-1.4	14-Aug-86	85	0				0				0		20
Racehorse Cr.	0.0-1.4	24-Aug-86	99	0				0				0		20
Racehorse Cr.	0.0-1.4	07-Sep-86	95	0				0				0		20
Thompson Cr.	0.0-0.8	11-Aug-86	95	0				0				0		20
Thompson Cr.	0.0-0.3	04-Sep-86	99	0				0				0		20

North Fork Nooksack Mainstem Reaches

Welcome Bridge	40.5-40.8	30-Aug-86	5	0				0				0		05,09,38
Bell	40.8-41.1	10-Aug-86	5	0				0				0		04,08,38
Bell	40.8-41.1	30-Aug-86	5	0				0				0		04,08,38
Rest Area	41.3-42.0	10-Aug-86	5	0				0				0		04,08,38
Rest Area	41.3-42.0	30-Aug-86	5	0				0				0		04,08,38
Kenny	42.1-42.5	10-Aug-86	5	0				0				0		04,08,38
Coal	44.6-45.4	08-Aug-86	5	0				0				0		04,08,38
Coal	44.6-45.4	24-Aug-86	5	0				0				0		04,08,38
Coal	44.6-45.4	30-Aug-86	5	0				1	1	0	0	1		04,08, fish at RM45.4
Coal	44.6-45.4	07-Sep-86	5	0				0				0		04,08,25
Coal	44.6-45.4	15-Sep-86	30	2	0	0	2	4	0	3	1	6		04,08,21
Racehorse Slough	45.0-45.1	08-Aug-86	90	0				0				0		20, upper part filled
Racehorse Slough	45.0-45.1	14-Aug-86	90	0				0				0		20, upper part filled
Racehorse Slough	45.0-45.1	24-Aug-86	99	0				0				0		20, upper part filled
Racehorse Slough	45.0-45.1	07-Sep-86	99	0				0				0		20, upper part filled
Johnies Slough	00.0-00.1	08-Aug-86	80	0				0				0		20
Johnies Slough	00.0-00.1	14-Aug-86	80	0				0				0		20
Johnies Slough	00.0-00.1	24-Aug-86	99	0				0				0		20
Johnies Slough	00.0-00.1	07-Sep-86	95	0				0				0		20
Johnies Slough	00.2-00.5	07-Sep-86	95	0				0				0		20
Racehorse	45.0-45.7	08-Aug-86	5	0				0				0		09,28,38
Racehorse	45.6-45.7	07-Sep-86	5	0				0				0		09,25
Kendall	45.6-46.2	08-Aug-86	5	0				0				0		04,08,38
Kendall	45.6-45.9	17-Aug-86	10	0				0				0		04,08,38
Kendall	45.6-46.2	24-Aug-86	5	0				0				0		04,08,38
Kendall	45.6-46.2	30-Aug-86	5	2	0	1	1	0				2		04,08, ch-46.0, 46.2
Kendall	45.5-46.2	07-Sep-86	5	0				0				0		04,08,25
Kendall	45.6-46.2	15-Sep-86	30	0				2	1	1	0	2		21
Upper Racehorse	46.5-47.1	14-Aug-86	5	0				0				0		05,09,38
Upper Racehorse	46.2-47.0	07-Sep-86	5	1	0	0	1	0				1		05,09,25
Kendall Farmhouse	46.8-47.3	18-Aug-86	5	3	0	0	3	0				3		04,08,60
Kendall Farmhouse	46.8-47.6	25-Aug-86	5	6	0	0	6	0				6		04,08,
Kendall Farmhouse	46.8-47.6	31-Aug-86	5	1	0	0	1	0				1		04,08, fish at RM46.9
Kendall Farmhouse	46.8-47.6	08-Sep-86	15	15	0	1	14	5	0	5	0	20		04,08,25
Kendall Farmhouse	46.8-47.8	14-Sep-86	30	4	0	0	4	9	0	8	1	13		21
Glen	47.6-48.3	25-Aug-86	5	6	0	2	4	0				6		04,08
Glen	47.6-48.3	31-Aug-86	5	0				0				0		04,08,38
Glen	47.6-48.3	08-Sep-86	15	0				0				0		04,08,25

Maple	49.7-49.9	09-Aug-86	5	0				0				0		04, 08, 38
Maple	49.7-49.8	17-Aug-86	5	0				0				0		04, 08, 38
Maple	49.7-49.8	22-Aug-86	5	0				0				0		04, 08, 38
Maple	49.7-50.0	30-Aug-86	5	0				0				0		04, 08, 38
Aldrich	51.2-52.0	17-Aug-86	5	0				0				0		05, 09, 38
Aldrich	51.2-52.0	23-Aug-86	15	0				0				0		05, 09, 38
Aldrich	51.2-52.0	06-Sep-86	10	4	0	0	4	1	0	0	1	5		05, 09, 38
Aldrich	51.2-52.0	13-Sep-86	10	2	0	2	0	4	0	1	3	6	6	05, 09, 21
Boulder	51.9-52.2	09-Aug-86	5	0				0				0		04, 08, 38
Boulder	51.8-52.3	22-Aug-86	5	4	0	1	3	0				4		04, 08, 38
Boulder	51.8-52.3	30-Aug-86	25	13	0	2	11	0				13	6	04, 08, 38
Boulder	51.8-52.3	06-Sep-86	5	0				0				0		04, 08, 25
Boulder	51.8-52.3	13-Sep-86	10	8	0	0	8	0				8	12	04, 08, 21
Canyon	54.8-55.2	11-Aug-86	5	0				0				0		04, 08, 38
Canyon	54.8-55.2	18-Aug-86	5	2	0	0	2	0				2		04, 08, 60
Canyon	54.8-55.2	25-Aug-86	5	0				0				0		04, 08, 38
Canyon	54.8-55.2	31-Aug-86	5	0				0				0		04, 08, 38
Canyon	54.8-55.2	08-Sep-86	5	0				1	0	1	0	1		04, 08, 25
Canyon	54.8-55.2	15-Sep-86	40	0				0				0		20
Hedrick	55.9-56.2	22-Aug-86	10	4	0	1	3	0				4	1	05, 38, 60
Hedrick	55.9-56.2	30-Aug-86	15	0				1	0	1	0	1		05, 09, fish at RM56.0
Hedrick	55.9-56.2	06-Sep-86	40	2	0	0	2	1	0	1	0	3		05, 09, 28
Hedrick	55.9-56.3	13-Sep-86	20	1	0	0	1	4	0	3	1	5	4	05, 09, 21
Gallup	57.4-57.5	09-Aug-86	5	0				0				0		09, 38
Gallup	57.3-57.6	22-Aug-86	5	0				0				0		05, 09, 38
Gallup	57.4-57.5	04-Sep-86	5	0				0				0		09, 25
Boyd	62.0-62.5	10-Aug-86	25	0				0				0		05, 09
Boyd	62.0-62.3	15-Aug-86	5	0				0				0		05, 09, 38
Boyd	62.0-62.5	23-Aug-86	10	0				0				0		05, 09, 38
Boyd	62.0-62.5	04-Sep-86	5	0				0				0		09, 25
Boyd	62.0-62.3	12-Sep-86	15	0				0				0		05, 09, 24
Nooksack Camp	62.3-62.5	15-Aug-86	5	0				0				0		04, 08, 38
Nooksack Camp	62.3-62.7	12-Sep-86	30	0				0				0		04, 08, 24
Bridge Camp	62.9-spot	10-Aug-86	5	0				0				0		09, 38
Bridge Camp	62.7-63.0	15-Aug-86	5	0				0				0		05, 09, 38
Bridge Camp	62.7-63.0	23-Aug-86	10	0				0				0		05, 09, 38
Bridge Camp	62.7-63.0	04-Sep-86	10	0				0				0		05, 09, 25
Bridge Camp	62.4-63.0	12-Sep-86	30	0				0				0		05, 09, 24
Deadhorse	63.4-spot	10-Aug-86	5	0				0				0		09, 38
Deadhorse	63.3-63.5	15-Aug-86	5	0				0				0		05, 09, 38
Deadhorse	63.3-63.5	23-Aug-86	20	0				0				0		05, 09, 38
Deadhorse	63.3-63.5	04-Sep-86	10	0				0				0		05, 09, 25
Deadhorse	63.3-63.5	12-Sep-86	15	0				1	0	1	0	1		05, 09, 60
Powerhouse	64.1-64.5	15-Aug-86	5	0				0				0		08
Powerhouse	64.1-64.5	12-Sep-86	30	0				0				0		08, 24

Middle Fork Nooksack Mainstem Reach

Mouth	00.0-00.2	30-Aug-86	5	0				0				0		04, 08, 38
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APPENDIX II. USFWS 1985 NORTH FORK NOOKSACK SPRING CHINOOK
SURVEY AREA TOTALS, (USING HIGHEST LIVE, DEAD OR REDD COUNTS). *

Area	Type of Count (Number)	# of Fish Represented
Canyon Cr.	Live (9); Redd (13)	9 (to 26)
Kendall Cr. **	Dead (4); Redd (7)	4 (to 14)
N.F. Nooksack		
Coal Creek Slough **	Dead (9)	9
Racehorse Slough **	Live & Dead (16); Redd (9)	16 (to 18)
Johnies Slough	Dead (1); Redd (1)	1 (to 2)
RB Kendall Hatch. **	Dead (5)	5
LB Kendall Hatchery	Dead (6)	6
RB Kendall Farmhouse	Live & Dead (3)	3
LB Kendall Farmhouse	Live & Dead (23)	23
RB Upper Kendall Farmhouse	Dead (3); Redd (2)	3 (to 4)
LB Aldrich	Live & Dead (13); Redd (10)	13 (to 20)
RB Boulder	Dead (2)	2
RB Canyon	Dead (1)	1
Total Fish		95 (to 133)

* Please note this is not a population estimate; actual populations are likely substantially higher. Areas without sightings not included.

** Includes results of two Lummi Fisheries Department surveys in the Kendall vicinity.

APPENDIX III
ANNUAL PEAK SPRING CHINOOK COUNTS FOR N.F. NOOKSACK TRIBUTARIES.

STREAM	PEAK COUNTS	COMMENTS
Bell Cr. (0390)	1985 - 0 fish	Stream dry
	1986 - 0 fish	Stream too low
Kenney Cr. (0392)	1978 - 3 fish	
	1980 - 0 fish	
	1981 - 1 fish	
	1986 - 0 fish	RM 0.0 - 0.1 surveyed
Racehorse Cr. (0394)	1947 - 1 fish	
	1951 - 1 fish	
	1961 - 9 fish	11 fish per mile
	1976 - 0 fish	
	1977 - 1 fish	
	1978 - 12 fish	24 fish per mile
	1979 - 35 fish	43 fish per mile
	1980 - 10 fish	12 fish per mile; stream too low
	1981 - 0 fish	
	1982 - 2 fish	
	1983 - 2 fish	
	1984 - 0 fish	
	1985 - 0 fish	Stream dry in gravel deposits
	1986 - 0 fish	Stream too low
Coal Cr. (0402)	1963 - 1 fish	
	1982 - 0 fish	
	1985 - 0 fish	Dry at mouth
	1986 - 0 fish	Dry at mouth
Kendall Cr. (0406)	1947 - 8 fish	
	1951 - 12 fish	120 fish per mile (RM 0.0 - 0.1)
	1961 - 13 fish	130 fish per mile (RM 0.0 - 0.1)
	1963 - 9 fish	
	1973 - 1 fish	
	1976 - 7 fish	35 fish per mile
	1977 - 10 fish	50 fish per mile (RM 0.0 - 0.2)
	1979 - 34 fish	170 fish per mile
	1981 - 44 fish	440 fish per mile (RM 0.3 - 0.4)
	1982 - 2 fish	
	1983 - 87 fish	
	1984 - 16 fish	
	1985 - 16 fish	
	1986 - 13 fish	
Maple Cr. (0415)	1976 - 0 fish	
	1978 - 0 fish	
	1979 - 3 fish	
	1980 - 13 fish	
	1981 - 30 fish	
	1982 - 1 fish	
	1983 - 0 fish	
	1984 - 1 fish	
	1985 - 0 fish	Habitat silted, flow sluggish
	1986 - 0 fish	Habitat silted, flow sluggish
Boulder Cr. (0424)	1945 - 0 fish	
	1946 - 0 fish	

	1955 - 1 fish	
	1975 - 1 fish	
	1976 - 0 fish	
	1977 - 2 fish	
	1978 - 3 fish	
	1979 - 1 fish	
	1980 - 0 fish	
	1981 - 14 fish	70 fish per mile
	1982 - 2 fish	
	1983 - 0 fish	
	1984 - 0 fish	Stream too low
	1985 - 0 fish	Stream too low
	1986 - 0 fish	Stream too low
Canyon Cr. (0437)	1943 - 1 fish	
	1945 - 2 fish	
	1961 - 10 fish	
	1979 - 6 fish	
	1980 - 8 fish	
	1981 - 208 fish	173 fish per mile
	1982 - 11 fish	
	1983 - 1 fish	
	1984 - 1 fish	
	1985 - 9 fish	
	1986 - 4 fish	Lack of suitable gravel
Hedrick Cr. (0463)	1982 - 0 fish	
	1983 - 0 fish	
	1984 - 0 fish	
	1985 - 0 fish	Stream too low
	1986 - 0 fish	Stream too low
Cornell Cr. (0464)	1945 - 7 fish	
	1947 - 20 fish	33 fish per mile
	1961 - 1 fish	
	1975 - 1 fish	
	1976 - 12 fish	20 fish per mile
	1977 - 10 fish	17 fish per mile
	1978 - 2 fish	
	1982 - 0 fish	
	1983 - 0 fish	
	1984 - 0 fish	
	1985 - 0 fish	Stream too low; gravel deposition
	1986 - 0 fish	Stream too low; gravel deposition
Gallop Cr. (0468)	1978 - 0 fish	
	1982 - 0 fish	
	1983 - 0 fish	
	1984 - 0 fish	
	1985 - 0 fish	
	1986 - 0 fish	
Glacier Cr. (0469)	1985 - 0 fish	
	1986 - 0 fish	
Thompson Cr. (0472)	1975 - 0 fish	
	1976 - 0 fish	
	1978 - 0 fish	
	1982 - 0 fish	
	1983 - 0 fish	
	1986 - 0 fish	
Coal Cr. (0487)	1982 - 0 fish	Stream dry

Boyd Cr. (0490)	1976 - 0 fish	
	1982 - 0 fish	
	1983 - 0 fish	
	1984 - 0 fish	
	1985 - 0 fish	Stream dry at mouth
	1986 - 0 fish	Stream too low
Lookout Cr. (0491)	1982 - 0 fish	Stream dry
Fossil Cr. (0492)	1982 - 0 fish	Stream dry
Cascade Cr. (0493)	1983 - 0 fish	Stream dry
Deadhorse Cr. (0495)	1976 - 0 fish	
	1980 - 0 fish	
	1981 - 3 fish	
	1982 - 5 fish	
	1983 - 0 fish	
	1984 - 0 fish	
	1985 - 0 fish	
	1986 - 0 fish	

